

EFFECT OF THIRAM AND CAPTAN FUNGICIDES ON NODULATION AND BIOLOGICAL NITROGEN FIXATION IN SOYBEAN

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ABSTRACT

Fungicides in soil may originate from soil treatment, seed dressing or as run off from foliar sprays. The use of fungicides to prevent seed and root diseases is essential for the production of Soybeans. In the present investigation two seed protectant fungicides Captan and Thiram were used. Effect of fungicides on growth of *Rhizobium japonicum* was studied. Soybean seeds of two varieties PK-472 and JS-72-44 were treated with the said fungicides. Observations were taken after 21, 30 and 45 days. Results reveal that captan is toxic to the nodule bacterium. So seed treatment with thiram should be followed as a routine.

Keywords: Thiram, captan, fungicides, *Rhizobium japonicum* and Soybean.

INTRODUCTION

Fungicidal seed dressing used to improve the early plant emergence are often damaging to *Rhizobium* applied as inoculant to legume seed. Some reports claim little damage, which may reflect the considerable variation within and in between different groups of *Rhizobium* in their sensitivity to fungicides¹.

Nodulation, nitrogen fixation and growth of various legumes can be inhibited by pesticides².

Generally, most efficient fungicides have been the most damaging to *Rhizobia* as typified by the organo-mercurial fungicides³.

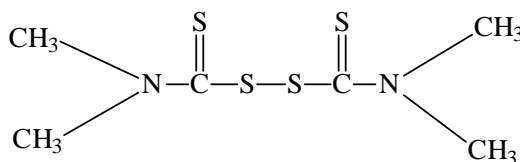
MATERIAL AND METHODS

Research field of Biofertilizer plant, M.P. Agro Industries, Indrapuri, Bhopal was chosen for the study. Soil samples collected from upper layer of soil upto a depth of 15 cm. Samples were air dried and sieved through 20mm sieve. The physical and chemical analysis of soil was made by following standard procedures.

Fungicides Thiram and Captan were used in this investigation.

Common name - Thiram, Source- M.P. Agro Pesticide Plant, Beena. Chemical name - Tetramethyl Thiram disulphide.

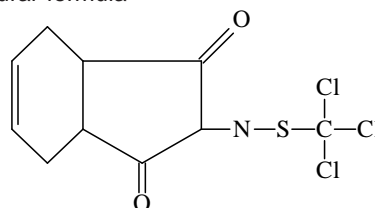
Structural formula of Thiram



Common name - Captan, Source- Rallis India Ltd., Mumbai.

Chemical name - N-trichloromethylthio-4-cyclohexene-1,2-dicarboximide.

Structural formula



Organism - 30-40 days old Soybean plants were uprooted Brady *Rhizobium japonicum* cultures isolated. Organism was grown and maintained on yeast extract mannitol agar medium. Ten days old nine cultures i.e. CH 1,2,3,4,5,6,7A,7B, 7C incubated at 28±2°C were used throughout the investigation.

Field trial

Seeds of Soybean were inoculated with Brady *Rhizobium japonicum* culture at the rate of

Table 1-2 : Influence of Captan fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial*

S. No.	Isolate No.	Shoot length (cm)	Root length (cm)	No. of nodules		Total No.
				On tap root	On lateral roots	
(Soybean seeds of PK-472 variety)						
1.	CH-1	30.9	22.9	17.1	22.0	39.1
2.	CH-2	28.9	21.3	16.5	21.1	37.6
3.	CH-3	29.3	18.0	10.6	7.6	18.2
4.	CH-4	26.5	19.5	15.3	5.9	21.2
5.	CH-5	26.2	18.6	12.3	8.7	21.0
6.	CH-6	23.0	18.9	17.0	17.0	34.0
7.	CH-7A	24.6	20.8	11.6	7.9	19.5
8.	CH-7B	28.8	19.2	15.3	4.3	19.6
9.	CH-7C	29.5	18.2	16.9	19.1	36.0
++		34.9	40.5	-	-	90.3
(Soybean seeds of JS-72-44 variety)						
1.	CH-1	29.3	20.9	16.3	21.3	37.6
2.	CH-2	26.3	18.6	15.6	20.9	36.5
3.	CH-3	28.4	17.6	9.5	7.5	17.0
4.	CH-4	25.9	18.3	14.8	6.3	21.1
5.	CH-5	25.8	17.5	11.6	7.8	19.4
6.	CH-6	21.3	17.2	18.6	16.1	34.7
7.	CH-7A	23.2	19.1	10.9	6.8	17.7
8.	CH-7B	27.6	20.3	14.6	4.6	19.2
9.	CH-7C	27.3	17.6	15.6	18.8	34.4
++		39.52	38.41	-	-	112.8

Table 3-4 : Influence of Thiram fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial*

(Soybean seeds of PK-472 variety)						
1.	CH-1	31.6	24.4	17.0	23.2	40.2
2.	CH-2	31.2	21.0	15.2	22.0	37.2
3.	CH-3	28.3	18.5	12.5	8.5	21.0
4.	CH-4	27.8	20.6	16.3	6.4	20.7
5.	CH-5	27.4	19.3	13.5	9.2	22.7
6.	CH-6	21.0	19.0	18.9	18.1	37.0
7.	CH-7A	25.6	21.2	12.3	8.2	20.5
8.	CH-7B	30.1	20.1	16.4	5.6	22.0
9.	CH-7C	30.1	19.5	17.1	23.0	40.1
++		37.99	49.69	-	-	99.0
(Soybean seeds of JS-72-44 variety)						
1.	CH-1	30.8	23.4	16.5	23.2	39.7
2.	CH-2	26.5	20.9	17.6	21.0	38.6
3.	CH-3	27.9	17.6	11.9	8.0	19.9
4.	CH-4	30.4	19.8	15.4	5.8	21.2
5.	CH-5	26.9	18.6	12.8	8.9	21.7
6.	CH-6	20.4	18.5	17.2	17.6	34.8
7.	CH-7A	24.8	20.9	11.3	7.5	18.8
8.	CH-7B	28.6	20.0	15.6	5.9	21.5
9.	CH-7C	29.5	19.1	16.9	19.6	36.5
++		46.66	54.9	-	-	130.8

* Observation after 21 days ++ Percentage increase over control

Table 5-6 : Influence of seed bacterization with test isolates of *Rhizobium japonicum* in field trial*

S. No.	Isolate No.	Shoot length (cm)	Root length (cm)	No. of nodules		Total No.
				On tap root	On lateral roots	
(Soybean seeds of PK-472 variety)						
1.	CH-1	33.9	22.9	15.0	20.4	35.4
2.	CH-2	30.6	18.2	14.8	20.5	35.3
3.	CH-3	32.8	21.3	9.9	13.9	23.8
4.	CH-4	32.8	20.8	7.6	12.6	20.2
5.	CH-5	22.9	20.7	11.8	10.7	22.5
6.	CH-6	23.2	19.9	17.5	8.8	26.3
7.	CH-7A	32.5	16.3	9.6	11.5	21.1
8.	CH-7B	32.0	18.9	8.8	12.9	21.7
9.	CH-7C	32.7	16.6	11.0	12.2	23.2
(Soybean seeds of JS-72-44 variety)						
1.	CH-1	32.0	21.2	12.0	20.2	32.2
2.	CH-2	28.6	17.6	13.6	18.3	31.9
3.	CH-3	31.0	20.9	8.1	12.2	20.3
4.	CH-4	31.2	18.6	6.2	11.0	17.2
5.	CH-5	21.0	19.5	10.8	8.9	19.7
6.	CH-6	22.8	18.2	16.2	7.5	23.7
7.	CH-7A	31.3	15.3	8.2	10.3	18.5
8.	CH-7B	31.0	17.0	7.3	11.5	18.8
9.	CH-7C	30.9	15.1	9.0	11.9	20.9

Table 7-8 : Influence of Thiram fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial*

(Soybean seeds of PK-472 variety)						
1.	CH-1	42.0	24.9	27.0	23.6	50.6
2.	CH-2	39.9	22.3	12.9	35.2	48.1
3.	CH-3	35.3	23.6	17.0	17.9	34.9
4.	CH-4	33.5	21.8	15.5	12.6	28.1
5.	CH-5	38.2	23.7	15.8	21.8	37.6
6.	CH-6	38.5	22.9	12.7	28.2	40.9
7.	CH-7A	32.1	21.0	15.2	12.8	28.0
8.	CH-7B	33.0	23.8	6.9	19.7	26.6
9.	CH-7C	41.2	20.9	25.4	25.4	40.8
++		24.26	19.7	-	-	108.2
(Soybean seeds of JS-72-44 variety)						
1.	CH-1	41.2	23.1	26.2	21.1	47.3
2.	CH-2	38.3	20.9	10.5	33.6	44.1
3.	CH-3	34.0	21.6	15.4	16.2	31.6
4.	CH-4	32.1	20.2	13.2	10.5	23.7
5.	CH-5	37.5	22.0	14.0	20.2	34.2
6.	CH-6	37.0	21.3	10.6	26.9	37.5
7.	CH-7A	31.0	20.9	5.7	17.0	22.7
8.	CH-7B	32.0	19.5	13.5	10.3	23.8
9.	CH-7C	40.2	19.0	14.0	25.1	39.1
++		26.75	19.7	-	-	103.8

* Observation after 21 days

++ Percentage increase over control

Table 9 : Influence of Captan fungicide and seed bacterization with test isolates of *Rhizobium japonicum* in field trial*

S. No.	Isolate No.	Shoot length (cm)	Root length (cm)	No. of nodules		Total No.
				On tap root	On lateral roots	
(Soybean seeds of JS-72-44 variety)						
1.	CH-1	44.2	25.2	18.7	40.8	59.5
2.	CH-2	43.4	23.3	21.3	38.2	59.5
3.	CH-3	40.8	22.5	8.5	34.5	43.0
4.	CH-4	39.6	22.6	8.9	28.4	37.3
5.	CH-5	38.2	23.0	12.6	27.6	40.2
6.	CH-6	37.6	21.4	16.4	40.2	56.2
7.	CH-7A	37.0	24.2	17.5	24.3	41.8
8.	CH-7B	36.8	22.6	13.3	28.3	41.6
9.	CH-7C	42.6	24.1	8.2	44.0	52.2
++		43.51	31.25	-	-	68.0

Table - 10: Effect of Thiram fungicide on Soybean seeds of PK-472 variety

S. No.	Isolate No.	Branches per pod	Pods/plant in gms	Seed/pod	Grain yield/plant in gms
1.	CH-1	5.8	80.3	2.15	14.33
2.	CH-2	5.7	80.0	2.14	14.33
3.	CH-3	5.6	78.1	2.05	14.21
4.	CH-4	5.5	79.0	2.09	14.26
5.	CH-5	5.6	77.2	2.06	14.00
6.	CH-6	5.8	80.4	2.15	14.34
7.	CH-7A	5.4	78.0	2.09	14.20
8.	CH-7B	5.6	77.3	2.07	14.26
9.	CH-7C	5.79	80.2	2.14	14.30

Table - 11: Effect of Thiram fungicide on Soybean seeds of JS-72-44 variety

1.	CH-1	5.6	79.0	2.14	14.26
2.	CH-2	5.65	78.0	2.13	14.29
3.	CH-3	5.5	77.3	2.04	14.19
4.	CH-4	5.48	77.0	2.07	14.03
5.	CH-5	5.45	76.9	2.03	13.99
6.	CH-6	5.7	79.0	2.14	14.28
7.	CH-7A	5.4	77.1	2.08	14.06
8.	CH-7B	5.5	77.2	2.03	14.09
9.	CH-7C	5.6	78.0	2.13	14.27

Table - 12: Effect of bacterization on Soybean seeds of PK-573 variety

1.	CH-1	5.62	78.4	2.13	14.20
2.	CH-2	5.49	79.2	2.12	14.18
3.	CH-3	5.38	76.3	2.03	14.15
4.	CH-4	5.49	78.1	2.07	14.19
5.	CH-5	5.50	76.3	2.03	13.80
6.	CH-6	5.70	78.2	2.11	14.26
7.	CH-7A	5.32	76.9	2.07	14.12
8.	CH-7B	5.50	75.9	2.05	14.23
9.	CH-7C	5.69	79.3	2.10	14.26

Table - 13: Effect of Bacterization on Soybean seeds of JS-72-44 variety

S. No.	Isolate No.	Branches per pod	Pods/plant in gms	Seed/pod	Grain yield/plant in gms
1.	CH-1	5.59	77.9	2.10	14.18
2.	CH-2	5.36	78.3	2.09	14.13
3.	CH-3	5.29	76.0	2.00	14.09
4.	CH-4	5.38	77.8	2.03	14.16
5.	CH-5	5.48	75.9	2.01	13.75
6.	CH-6	5.65	77.3	2.09	14.16
7.	CH-7A	5.29	75.8	2.03	14.09
8.	CH-7B	5.42	74.2	2.02	14.19
9.	CH-7C	5.53	78.7	2.08	14.23

Table - 14: Effect of Captan fungicide on Soybean seeds of PK-472 variety

S. No.	Isolate No.	Branches per pod	Pods/plant in gms	Seed/pod	Grain yield/plant in gms
1.	CH-1	5.6	78.2	2.10	14.30
2.	CH-2	5.5	79.3	2.10	14.30
3.	CH-3	5.4	77.6	2.00	14.19
4.	CH-4	5.0	78.4	2.03	14.24
5.	CH-5	5.5	76.0	2.04	13.95
6.	CH-6	5.3	79.2	2.13	14.26
7.	CH-7A	5.4	77.1	2.08	14.18
8.	CH-7B	5.5	76.2	2.03	14.20
9.	CH-7C	5.6	80.0	2.09	14.28

Table - 15: Effect of Captan fungicide on Soybean seeds of JS-72-44 variety

S. No.	Isolate No.	Branches per pod	Pods/plant in gms	Seed/pod	Grain yield/plant in gms
1.	CH-1	5.5	78.0	2.10	14.23
2.	CH-2	5.5	77.6	2.09	14.23
3.	CH-3	5.3	76.0	1.95	14.17
4.	CH-4	5.4	76.3	1.97	14.00
5.	CH-5	5.39	75.8	2.00	13.96
6.	CH-6	5.6	78.0	2.09	14.25
7.	CH-7A	5.3	76.3	2.05	13.65
8.	CH-7B	5.4	76.2	2.00	13.93
9.	CH-7C	5.4	77.0	2.08	14.20

5 gms of inoculant to each Kg. of Soybean seeds and 4% of jaggery solution prepared in distilled water was used as a sticker. Following air drying, seed samples were dry dusted with 0.25% by weight each of the fungicides. The plants were uprooted after 21, 30 and 45 days of their germination. In the control set fungicides were not used but seeds were inoculated with culture isolates.

RESULTS AND DISCUSSION

Results reveal that Captan is toxic to the nodule bacterium in comparison to Thiram. Toxicity of Captan has been reported by Sindhu and Kahlan (1971) and Hawaz and Coworkers (1972).

Thiram is observed to be compatible with nodule bacterium. Observation is supported by Dr. Duzek and coworkers from Canada.

Among the different isolates CH-1, CH-2, CH-6, CH-7C were observed to give better results.

After 45 days of sowing Soybean plants were quite healthy. Nodule size and colour was also dark pink indicative of effectiveness of nitrogen fixation in case of Thiram treated seeds.

Thiram is reported to be detrimental in some studies as observed by Tu (1981), Rienne and Dubtz (1984) but harmless by other Curley and Burton (1975).

The present finding suggests that Soybean seed treatment should be followed as a routine.

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